

## CLAIMS

What is claimed is:

1. An infrared absorbing compound, the compound comprising x wt% K units, y wt% L units, and z wt% of M units, in which:

5 (i) K is selected from  $-\text{[CH}_2\text{C(R}^1\text{)R}^2\text{]}-$ ,  $-\text{[CH}_2\text{CR}^1(\text{CO}_2\text{R}^3\text{)]-}$ ,  $-\text{[CH}_2\text{CR}^1(\text{CONR}^3_2\text{)]-}$ ,  $-\text{[CH(COECO)CH]}-$ , and mixtures thereof;

(ii) L is  $-\text{[CH}_2\text{C(R}^4\text{)CO}_2\text{B}_n\text{T]}-$ ; and

(iii) M is  $-\text{[CH}_2\text{C(R}^4\text{)(-Q-G}^\oplus\text{)(D}^\ominus\text{)]-}$  or  $-\text{[CH}_2\text{C(R}^4\text{)(G}^\oplus\text{)(D}^\ominus\text{)]-}$ ;

in which:

10 (i) K is selected from  $-\text{[CH}_2\text{C(R}^1\text{)R}^2\text{]}-$ ,  $-\text{[CH}_2\text{CR}^1(\text{CO}_2\text{R}^3\text{)]-}$ ,  $-\text{[CH}_2\text{CR}^1(\text{CONR}^3_2\text{)]-}$ ,  $-\text{[CH(COECO)CH]}-$ , and mixtures thereof;

(ii) L is  $-\text{[CH}_2\text{C(R}^4\text{)CO}_2\text{B}_n\text{T]}-$ ; and

(iii) M is  $-\text{[CH}_2\text{C(R}^4\text{)(-Q-G}^\oplus\text{)(D}^\ominus\text{)]-}$  or  $-\text{[CH}_2\text{C(R}^4\text{)(G}^\oplus\text{)(D}^\ominus\text{)]-}$ ;

in which:

15  $x + y + z = \text{about } 100 \text{ wt\%};$

each  $\text{R}^1$  is independently hydrogen, alkyl of one to six carbon atoms, phenyl, substituted phenyl, or cyano; each  $\text{R}^2$  is independently hydrogen, alkyl of one to six carbon atoms, phenyl, substituted phenyl, halogen, cyano, alkoxy of one to four carbon atoms, acyl of one to five carbon atoms, acyloxy of one to five carbon atoms, allyl,  $-\text{CH}_2\text{CH}_2\text{OCH}_2\text{CH}_3$ ,  $-\text{CH}_2\text{CH}_2\text{SO}_2\text{CH}_3$ ,  $-\text{NHC(O)H}$ ,  $-\text{NHC(O)CH}_3$ ,  $-\text{Si(CH}_3\text{)}_3$ ,  $-\text{Si(OCH}_3\text{)}_3$ , or a cyclic  $-\text{[NC(O)CH}_2\text{CH}_2\text{CH}_2\text{]}$  group; or  $\text{R}^1$  and  $\text{R}^2$  together are  $-\text{CH}_2\text{C(O)OC(O)-}$ ,  $-(\text{CH}_2)_2\text{C(O)OC(O)-}$ , or  $-\text{CH}_2\text{C(O)OC(O)CH}_2-$ ;

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each  $\text{R}^3$  is independently hydrogen, alkyl of one to six carbon atoms, or phenyl;

25 each  $\text{R}^4$  is independently hydrogen, alkyl of one to six carbon atoms, phenyl, substituted phenyl, or cyano;

E is oxygen or  $\text{NR}^6$  in which each  $\text{R}^6$  is hydrogen, hydroxyl, phenyl, substituted phenyl, alkyl of one to six carbon atoms, or benzyl;

B is selected from  $-\text{CH}_2-\text{CH}(\text{R}^5)-\text{O}-$  and  $-\text{CH}_2-\text{C}(\text{R}^5)(\text{OH})-$ , in which each  $\text{R}^5$  is independently hydrogen or alkyl of one to six carbon atoms;

5        n is about 5 to about 400;

T is hydrogen, alkyl of one to eight carbon atoms, or phenyl;

Q is  $-\text{CO}_2(\text{CH}_2)_m-$ ,  $-\text{CONH}(\text{CH}_2)_m-$ ,  $-(\text{CH}_2)_m-$ ,  $-\text{CO}_2\text{C}_6\text{H}_4-$ , or  $-\text{C}_6\text{H}_4-$ , in which m is 1 to 5;

$\text{G}^\oplus$  is selected from ammonium, sulfonium, phosphonium, and iodonium; and

10         $\text{D}^0$  is selected from the group consisting of infrared absorbing cyanine anions that have a total of two to four groups selected from sulfonate groups, sulfate groups, and mixtures thereof; infrared absorbing oxonol anions; and mixtures thereof.

2.        The infrared absorbing compound of claim 1 in which

$\text{R}^1$  is hydrogen or methyl;

15         $\text{R}^2$  is phenyl or cyano;

$\text{R}^3$  is methyl,

$\text{R}^4$  is hydrogen or methyl;

$\text{R}^5$  is hydrogen, methyl, or a mixture thereof;

T is hydrogen, methyl, ethyl, or *n*-butyl; and

20        n is about 10 to about 100.

3.        The infrared absorbing compound of claim 2 in which x is about 30 wt% to about 98 wt%; y is about 1 wt% to about 50 wt%; and z is about 1 wt% to about 50 wt%.

4.        The infrared absorbing compound of claim 3 in which: B is  
25         $-\text{CH}_2-\text{CH}(\text{R}^5)-\text{O}-$ ; Q is  $-\text{CO}_2(\text{CH}_2)_m-$ ; and m is two to five.

5.        The infrared absorbing compound of claim 4 in which  $\text{G}^\oplus$  is ammonium.

6. The infrared absorbing compound of claim 5 in which  $D^{\ominus}$  is an infrared absorbing cyanine anion or mixture infrared absorbing cyanine anions.

7. The infrared absorbing compound of claim 5 in which  $D^{\ominus}$  is an infrared absorbing oxonol anion or mixture infrared absorbing oxonol anions.

5 8. The infrared absorbing compound of claim 5 in which x is about 60 wt% to about 98 wt%; y is about 2 wt% to about 30 wt%; and z is about 2 wt% to about 30 wt%.

9. The infrared absorbing compound of claim 8 in which  $G^{\oplus}$  is trimethyl ammonium.

10 10. The infrared absorbing compound of claim 1 in which:

$G^{\oplus}$  is ammonium;

B is  $-\text{CH}_2-\text{CH}(\text{R}^5)-\text{O}-$ ;

$\text{R}^1$  is hydrogen or methyl;

$\text{R}^2$  is phenyl or cyano;

15  $\text{R}^3$  is methyl,

$\text{R}^4$  is hydrogen or methyl;

$\text{R}^5$  is hydrogen, methyl, or a mixture thereof;

Q is  $-\text{CO}_2(\text{CH}_2)_m-$ ; and

m is two to five.

20 11. An imageable element comprising an imageable layer over a substrate, in which the imageable layer comprises an infrared absorbing compound comprising x wt% K units, y wt% L units, and z wt% of M units, in which:

(i) K is selected from  $-\text{CH}_2\text{C}(\text{R}^1)\text{R}^2-$ ,  $-\text{CH}_2\text{CR}^1(\text{CO}_2\text{R}^3)-$ ,  $-\text{CH}_2\text{CR}^1(\text{CONR}^3_2)-$ ,  $-\text{CH}(\text{COECO})\text{CH}-$ , and mixtures thereof;

25 (ii) L is  $-\text{CH}_2\text{C}(\text{R}^4)\text{CO}_2\text{B}_n\text{T}-$ ; and

(iii) M is  $-\text{[CH}_2\text{C(R}^4\text{)(-Q-G}^\oplus\text{)(D}^\ominus\text{)]-}$  or  $-\text{[CH}_2\text{C(R}^4\text{)(G}^\oplus\text{)(D}^\ominus\text{)]-}$ ;

in which:

$x + y + z = \text{about } 100 \text{ wt\%}$ ;

each  $\text{R}^1$  is independently hydrogen, alkyl of one to six carbon atoms, phenyl,  
 5 substituted phenyl, or cyano; each  $\text{R}^2$  is independently hydrogen, alkyl of one to six  
 carbon atoms, phenyl; substituted phenyl, halogen, cyano, alkoxy of one to four  
 carbon atoms, acyl of one to five carbon atoms, acyloxy of one to five carbon atoms,  
 allyl,  $-\text{CH}_2\text{CH}_2\text{OCH}_2\text{CH}_3$ ,  $-\text{CH}_2\text{CH}_2\text{SO}_2\text{CH}_3$ ,  $-\text{NHC(O)H}$ ,  $-\text{NHC(O)CH}_3$ ,  $-\text{Si(CH}_3\text{)}_3$ ,  
 $-\text{Si(OCH}_3\text{)}_3$ , or a cyclic  $-\text{[NC(O)CH}_2\text{CH}_2\text{CH}_2\text{]}$  group; or  $\text{R}^1$  and  $\text{R}^2$  together are  
 10  $-\text{CH}_2\text{C(O)OC(O)-}$ ,  $-(\text{CH}_2)_2\text{C(O)OC(O)-}$ , or  $-\text{CH}_2\text{C(O)OC(O)CH}_2-$ ;

each  $\text{R}^3$  is independently hydrogen, alkyl of one to six carbon atoms, or  
 phenyl;

each  $\text{R}^4$  is independently hydrogen, alkyl of one to six carbon atoms, phenyl,  
 substituted phenyl, or cyano;

15 E is oxygen or  $\text{NR}^6$  in which each  $\text{R}^6$  is hydrogen, hydroxyl, phenyl, substituted  
 phenyl, alkyl of one to six carbon atoms, or benzyl;

B is selected from  $-\text{CH}_2\text{-CH(R}^5\text{)-O-}$  and  $-\text{CH}_2\text{-C(R}^5\text{)(OH)-}$ , in which each  $\text{R}^5$  is  
 independently hydrogen or alkyl of one to six carbon atoms;

n is about 5 to about 400;

20 T is hydrogen, alkyl of one to eight carbon atoms, or phenyl;

Q is  $-\text{CO}_2(\text{CH}_2)_m-$ ,  $-\text{CONH}(\text{CH}_2)_m-$ ,  $-(\text{CH}_2)_m-$ ,  $-\text{CO}_2\text{C}_6\text{H}_4-$ , or  $-\text{C}_6\text{H}_4-$ , in which m  
 is 1 to 5;

$\text{G}^\oplus$  is selected from ammonium, sulfonium, phosphonium, and iodonium; and

$\text{D}^\ominus$  is selected from the group consisting of infrared absorbing cyanine anions  
 25 that have a total of two to four groups selected from sulfonate groups, sulfate groups,  
 and mixtures thereof; infrared absorbing oxonol anions; and mixtures thereof.

12. The imageable element of claim 11 in which:

$R^1$  is hydrogen or methyl;

$R^2$  is phenyl or cyano;

$R^3$  is methyl,

$R^4$  is hydrogen or methyl;

5  $R^5$  is hydrogen, methyl, or a mixture thereof;

T is hydrogen, methyl, ethyl, or *n*-butyl; and

*n* is about 10 to about 100.

13. The imageable element of claim 12 in which *x* is about 30 wt% to about 98 wt%; *y* is about 1 wt% to about 50 wt%; and *z* is about 1 wt% to about 50 wt%.

10 14. The imageable element of claim 13 in which:

$G^{\oplus}$  is ammonium; B is  $-\text{CH}_2\text{-CH}(\text{R}^5)\text{-O-}$ ; and Q is  $-\text{CO}_2(\text{CH}_2)_m\text{-}$ .

15. The imageable element of claim 14 in which the imageable layer consists essentially of the infrared absorbing compound.

15 16. The imageable element of claim 14 in which the imageable layer additionally comprises a co-binder, a monomer, and a thermally sensitive free radical generator.

17. A method for forming an image, the method comprising the steps of:

(a) thermally imaging an imageable element comprising an imageable layer over a substrate and forming an imaged imageable element comprising imaged and  
20 complementary unimaged regions in the imageable layer; and

(b) developing the imaged imageable element in an aqueous developer and removing the unimaged regions;

in which the imageable layer comprises an infrared absorbing compound comprising *x* wt% K units, *y* wt% L units, and *z* wt% of M units, in which:

25 (i) K is selected from  $-\text{[CH}_2\text{C}(\text{R}^1)\text{R}^2]\text{-}$ ,  $-\text{[CH}_2\text{CR}^1(\text{CO}_2\text{R}^3)]\text{-}$ ,  $-\text{[CH}_2\text{CR}^1(\text{CONR}^3_2)]\text{-}$ ,  $-\text{[CH}(\text{COECO})\text{CH-}]$ , and mixtures thereof;

(ii) L is  $-\text{[CH}_2\text{C(R}^4\text{)CO}_2\text{B}_n\text{T)]-}$ ; and

(iii) M is  $-\text{[CH}_2\text{C(R}^4\text{)(-Q-G}^\oplus\text{)(D}^\ominus\text{)]-}$  or  $-\text{[CH}_2\text{C(R}^4\text{)(G}^\oplus\text{)(D}^\ominus\text{)]-}$ ;

in which:

$x + y + z = \text{about } 100 \text{ wt\%}$ ;

5 each  $\text{R}^1$  is independently hydrogen, alkyl of one to six carbon atoms, phenyl, substituted phenyl, or cyano; each  $\text{R}^2$  is independently hydrogen, alkyl of one to six carbon atoms, phenyl, substituted phenyl, halogen, cyano, alkoxy of one to four carbon atoms, acyl of one to five carbon atoms, acyloxy of one to five carbon atoms, allyl,  $-\text{CH}_2\text{CH}_2\text{OCH}_2\text{CH}_3$ ,  $-\text{CH}_2\text{CH}_2\text{SO}_2\text{CH}_3$ ,  $-\text{NHC(O)H}$ ,  $-\text{NHC(O)CH}_3$ ,  $-\text{Si(CH}_3\text{)}_3$ ,  
 10  $-\text{Si(OCH}_3\text{)}_3$ , or a cyclic  $-\text{[NC(O)CH}_2\text{CH}_2\text{CH}_2\text{]}$  group; or  $\text{R}^1$  and  $\text{R}^2$  together are  $-\text{CH}_2\text{C(O)OC(O)-}$ ,  $-(\text{CH}_2)_2\text{C(O)OC(O)-}$ , or  $-\text{CH}_2\text{C(O)OC(O)CH}_2-$ ;

each  $\text{R}^3$  is independently hydrogen, alkyl of one to six carbon atoms, or phenyl;

15 each  $\text{R}^4$  is independently hydrogen, alkyl of one to six carbon atoms, phenyl, substituted phenyl, or cyano;

E is oxygen or  $\text{NR}^6$  in which each  $\text{R}^6$  is hydrogen, hydroxyl, phenyl, substituted phenyl, alkyl of one to six carbon atoms, or benzyl;

B is selected from  $-\text{CH}_2\text{-CH(R}^5\text{)-O-}$  and  $-\text{CH}_2\text{-C(R}^5\text{)(OH)-}$ , in which each  $\text{R}^5$  is independently hydrogen or alkyl of one to six carbon atoms;

20 n is about 5 to about 400;

T is hydrogen, alkyl of one to eight carbon atoms, or phenyl;

Q is  $-\text{CO}_2(\text{CH}_2)_m-$ ,  $-\text{CONH(CH}_2\text{)}_m-$ ,  $-(\text{CH}_2)_m-$ ,  $-\text{CO}_2\text{C}_6\text{H}_4-$ , or  $-\text{C}_6\text{H}_4-$ , in which m is 1 to 5;

$\text{G}^\oplus$  is selected from ammonium, sulfonium, phosphonium, and iodonium; and

25  $\text{D}^\ominus$  is selected from the group consisting of infrared absorbing cyanine anions that have a total of two to four groups selected from sulfonate groups, sulfate groups, and mixtures thereof; infrared absorbing oxonol anions; and mixtures thereof.

18. The method claim 17 in which:

R<sup>1</sup> is hydrogen or methyl;

R<sup>2</sup> is phenyl or cyano;

R<sup>3</sup> is methyl,

5 R<sup>4</sup> is hydrogen or methyl;

R<sup>5</sup> is hydrogen, methyl, or a mixture thereof;

T is hydrogen, methyl, ethyl, or *n*-butyl; and

n is about 10 to about 100.

10 19. The method of claim 18 in which x is about 30 wt% to about 98 wt%; y is about 1 wt% to about 50 wt%; and z is about 1 wt% to about 50 wt%.

20. The method of claim 19 in which:

G<sup>⊕</sup> is ammonium; B is -CH<sub>2</sub>-CH(R<sup>5</sup>)-O-; and Q is -CO<sub>2</sub>(CH<sub>2</sub>)<sub>m</sub>-.

21. The method of claim 20 in which the imaging step is carried out with infrared radiation.

15 22. The method of claim 21 in which the imageable layer consists essentially of the infrared absorbing compound.

23. The method of claim 21 in which the imageable layer additionally comprises a co-binder, a monomer, and a thermally sensitive free radical generator.

24. The method of claim 21 in which the aqueous developer is water.

20 25. The method of claim 21 in which the aqueous developer is fountain solution.

26. The method of claim 25 in which the imaging step and the developing step are carried out on press.